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CQA REPORT

CONSTRUCTION QUALITY ASSURANCE REPORT

Disposal Module 3.2 & 3.3 Liner System

Recology Hay Road

Revision 0

Submitted To: Recology Hay Road

Submitted By: Golder Associates Inc.
1000 Enterprise Way
Suite 190
Roseville, CA 95678 USA

Distribution:

3 Copies Recology Hay Road
1 Copy Golder Associates Inc.

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1.0 INTRODUCTION

1.1 Overview

Recology Hay Road (RHR) owns and operates the Recology Hay Road Facility. Disposal Modules (DM) 3.2 and 3.3 are Class II waste management units that were constructed in accordance with the project technical specifications, construction drawings, and construction quality assurance (CQA) plan. This construction was also completed in accordance with Waste Discharge Requirements (WDRs) Order No. R5-2008-0188, and the applicable requirements of federal Subtitle D regulations and Title 27 of the California Code of Regulations (CCR). The project site location is shown on Figure 1. Golder Associates Inc. (Golder) provided the CQA services for the construction of this base liner system.

This CQA Report documents construction activities and CQA monitoring and testing for construction of the DM-3.2/3.3 base liner system. Since a few construction tasks have not been completed at the time this report was prepared, this report certifies the following liner components:

- DM-3.2 and DM-3.3 subgrade
- DM-3.2 and DM-3.3 secondary geomembrane
- DM-3.2 and DM-3.3 leak detection system geocomposite
- DM-3.2 and DM-3.3 low-permeability soil liner
- DM-3.2 and DM-3.3 primary geomembrane
- DM-3.2 and DM-3.3 LCRS geocomposite
- DM-3.2 and DM-3.3 LCRS gravel
- DM-3.2 and DM-3.3 geotextile filter
- DM-3.2 operations layer (east of the phase line shown in Figure 3)

The following remaining liner system components have not been fully completed:

- DM-3.3 operations layer (west of the phase line shown in Figure 3)
- DM-3.2 and DM-3.3 leachate extraction system

These liner system components will be certified with an addendum to this CQA Report following completion.

1.2 Project Description

The combined DM-3.2 and DM-3.3 measures approximately 13.7-acres in plan area and is located immediately south of DM-3.1. Individually, DM-3.2 and DM-3.3 measure approximately 5.0-acres and 8.7-acres in area, respectively. DM-3.2/3.3 drains to two sumps at the southern end of the landfill. Figure

2 shows the site plan and relative location of DM-3.2/3.3. Figure 3 shows the grading plan for the DM-3.2/3.3 liner system.

The DM-3.2/3.3 base grades slope at 2 percent toward leachate collection lines oriented generally in a north-south direction. These leachate collection lines slope at 1 percent toward the southern perimeter berm. The southern perimeter berm is inclined at 2H:1V (horizontal to vertical) along the interior slope and inclined at 3H:1V along the exterior slope. The north side of the DM-3.2/3.3 primary liner system ties into the existing DM-3.1 and DM-4.2 base liner systems.

The base liner system is a double-composite liner system as described in the Liner Performance Demonstration Report prepared by Golder (April 15, 2003). The base liner containment system is comprised of the following components (from the bottom up):

- General earthfill (the upper 6-inches comprise of fine-grained soils)
- Secondary 60-mil HPDE geomembrane (double-sided textured)
- Leak detection geocomposite
- 2.5 feet of primary compacted clay liner ($k \leq 1 \times 10^{-7}$ cm/s, excluding the lower 6-inches)
- Primary 60-mil HPDE geomembrane (single or double-sided textured)
- 6-inch thick leachate collection and removal system (LCRS) gravel
- 8-oz. geotextile filter layer
- 1-foot thick operations layer

The side-slope liner system is a single-composite liner system. The side-slope liner containment system is comprised of the following components (from the bottom up):

- General earthfill
- Capillary barrier 30-mil HDPE geomembrane
- Geosynthetic clay liner (GCL)
- Primary 60-mil HPDE geomembrane (single or double-sided textured)
- LCRS geocomposite
- 1.5-feet of operations soil

1.3 Contractors

Construction of the DM-3.2/3.3 base liner system was performed by BostonPacific Inc. (BPI) of Dixon, who acted as the general contractor. The installation subcontractor for the geosynthetic liner system was D&E Construction (D&E) of Visalia, California. The 60-mil HDPE primary geomembrane, 60-mil HDPE secondary geomembrane, and Gundseal (GCL) material were provided by GSE, located in Houston, Texas. The geocomposite and geotextile were also provided by GSE. Approximately 4 panels of an alternate GCL were procured to fill a material shortage. This BentoLiner GCL was also manufactured by

GSE. The leachate extraction system was installed by Advance Wind, Solar, Hydro Power, Inc. (Advanced Power), located in Redwood Valley, California. Surveying for the project was completed by Bellecci & Associates, Inc. under subcontract to BPI.

1.4 Construction Quality Assurance

Golder provided CQA monitoring and testing services for the DM-3.2/3.3 base liner construction project according to the CQA Plan approved by the CVRWQCB. The CQA services consisted of observing, testing, and documenting the construction activities to verify compliance with the construction drawings and specifications. The CQA services included, but were not limited to:

- Review of manufacturer's submittals and conformance testing of the geosynthetic products
- Testing of the construction materials used for the general earthfill, low-permeability soil liner, LCRS gravel, and operations soil
- Observation of the geosynthetics installation and testing of the field seams for the HDPE geomembrane

Golder provided the lead CQA technician Debra M. Carroll from June 15, 2010 to September 3, 2010 to observe construction and perform field testing. From September 7, 2010 through September 20, 2010, additional technicians monitored the construction. All CQA activities were completed under Golder's supervision. Mr. Peter Bowers, P.E., provided project supervision as the CQA Engineer-of-Record.

Photographs documenting key components and activities of the construction process were taken on a regular basis. Selected photographs are included in Appendix A.

Daily field monitoring reports were prepared throughout the construction to document the construction and the CQA observation and testing. The field monitoring reports are included in Appendix B.

1.5 Project Documents

All work for the DM-3.2/3.3 base liner system was performed according to the construction drawings and specifications, which are listed below:

- "Construction Drawings, Recology Hay Road, Disposal Modules 3.2 & 3.3, Base Liner System, Solano County, California," prepared by Golder Associates, dated June 2010
- "Construction Specifications, Disposal Modules 3.2 & 3.3 Base Liner System, Recology Hay Road, Vacaville, California," prepared by Golder Associates, dated June 2010
- "Construction Quality Assurance Plan, Disposal Modules 3.2 & 3.3 Liner System, Recology Hay Road Landfill, Vacaville, California," prepared by Golder Associates, dated June 2010

1.6 Design Changes and Clarifications

Generally during the course a project, design changes and/or clarifications are processed to facilitate the construction process. However, no design changes or clarifications were needed during the construction of the DM-3.2/3.3 base liner system.

1.7 Surveying and Preparation of Record Drawings

Bellecci & Associates, Inc., under the supervision of Charles N. Capp, registered land surveyor, performed surveying for the project. Bellecci & Associates, Inc. established control points in the field for use by the contractor. Based on the control points, BPI performed construction grade control using Global Positioning System (GPS) technology. Bellecci & Associates, Inc. completed as-built surveys using the 50-foot grid system presented in the Drawings to determine the as-built elevations of each layer. As-built surveys were completed for the following:

- Top of general earthfill
- Top of low-permeability soil liner
- Top of LCRS gravel
- Top of operations soil

The record drawings prepared by Bellecci & Associates, Inc. are presented in Appendix C.

The location of each HDPE geomembrane panel was determined in the field using a measuring wheel. The record drawings for the HDPE geomembrane panels (primary and secondary layers) were prepared by D&E and reviewed by Golder. These drawings are also presented in Appendix C.

2.0 SUBGRADE PREPARATION AND GENERAL EARTHFILL

The subgrade preparation required for the construction of the DM-3.2/3.3 base liner system consisted of placing compacted general earthfill to the lines, grades and tolerances specified in the construction drawings. Approximately 78,000 cubic yards (cy) of general earthfill was excavated from the site borrow area and then used as general fill for base grades associated with DM-3.2/3.3. The perimeter levee on the east and south sides of DM-3.2/3.3 was previously constructed in 2008 during the DM-3.1 base liner construction. The borrow soils predominately consist of clays and silty clays.

General earthfill placement began on June 17, 2010. The general earthfill was excavated using a Caterpillar LG600 excavator and hauled to DM-3.2/3.3 using tandem belly-dump trucks. Excavation occurred from the soil borrow area located west of the landfill. Standing water in the borrow area was pumped out beginning in late April. BPI excavated and dewatering trenches in the borrow area following mobilization in June. In general, the soils were excavated at moisture contents that met specification requirements. However, some moisture conditioning took place when the soils were too wet or dry to meet compaction requirements. Compaction was performed with a Caterpillar 815 sheep foot compactor. General earth fill placement for the cell subgrade was completed on July 17, 2010.

CQA procedures for the general earthfill consisted of laboratory testing, monitoring placement methods, moisture conditioning, and determination of compaction using nuclear moisture-density testing methods (ASTM D6938). Laboratory testing of the general earthfill material consisted of Proctor compaction tests (ASTM D1557). Appendix D.1 includes the proctor compaction curves for the general earthfill. A summary of the in-situ density testing is presented in Appendix D.2. A total of 252 compaction tests were performed on an estimated 78,000 cy of soil, resulting in a testing frequency of 309 cy/test. The results of the compaction tests each measured a relative compaction of at least 90 percent. The project specifications required a minimum relative compaction of 90 percent in accordance with ASTM D 1557. The compaction test results indicated that the general earthfill was placed and compacted in accordance with the project specifications.

The general earthfill material was compacted to provide a firm and unyielding surface to support the liner system. At the completion of the placement and compaction, the exposed soils at the surface were systematically examined by Golder's CQA Technician to verify that the upper surface of the liner subgrade consisted of clay, silty clay, and/or sandy clay classified as CH, CL, or SC in accordance with the Unified Soil Classification System.

A topographic survey was prepared by Bellecci & Associates, Inc. Point data was also submitted and verified for compliance with the design grading tolerances by Golder. The survey elevations are indicated on the as-built topographic drawing, presented in Appendix C.

3.0 LOW-PERMEABILITY SOIL LINER

3.1 General

The low-permeability soil material was obtained from on-site clay soils contained in the borrow area located west of the landfill. Golder completed a borrow investigation on February 7, 2008. Soil obtained for placement as low-permeability soil liner was obtained from the horizontal and vertical range of the area investigated. Laboratory tests were performed on selected samples to verify suitability of the on-site soil for use as a low-permeability soil liner material. A test pad and field infiltration test was completed during the 2008 construction of DM-3.1 to verify that the proposed equipment and handling procedures would result in low-permeability soil liner that met the compaction and permeability requirements. Based on communication with the RWQCB, a test pad and field infiltration test is not required during the DM-3.2/3.3 construction since the low-permeability soil liner material will be obtained from the same borrow source location.

3.2 Low-Permeability Soil Liner Construction

The low-permeability soil liner is a 2.5-foot thick layer of compacted low-permeability soil in which the upper two feet is required to have a permeability of 1×10^{-7} cm/s or less. The soils used to construct this layer were obtained from the borrow area located west of the landfill. The low-permeability soil liner was constructed from July 17, 2010 through August 11, 2010.

The low-permeability soil consisted of brown, silty clay classified as a CH or CL in accordance with the Uniform Soil Classification Systems (USCS) per ASTM D2487. The soils exhibited an average Liquid Limit (LL) of 35, an average Plastic Index (PI) of 22 and average fines content (minus No. 200 sieve) of 71 percent. These values are very similar to those used in the previous DM-3.1 liner construction.

The low-permeability soil liner was constructed directly on top of the leak detection geocomposite. The first lift measured 12-inches in thickness to prevent construction damage to the underlying geosynthetic layers. The lower 6-inches of the first lift was placed as a foundation layer for the overlying 2-feet of low-permeability soil liner. Although the foundation layer was not tested for compaction or permeability, it was tested for Atterberg Limits and grain-size properties to establish that the material is the same as that used for the soil liner. The quantity of foundation layer material was estimated at 10,000 cy and the low-permeability soil liner was estimated at 40,000 cy, for a combined total of 50,000 cy.

The low-permeability soil liner material was excavated from the borrow area at moisture contents generally within the specified compaction window. Moisture was maintained in the placement area using a water truck or conditioned as necessary. The soil was excavated with a Caterpillar LG600 and hauled to DM-3.2/3.3 using tandem belly dump trucks. Following the initial 12-in lift, the soils were placed in 6 to

8-inch thick loose lifts and compacted with a Caterpillar 815 sheep foot compactor. Final grading was completed using a Caterpillar 140G grader.

The compaction window consisted of the same window used previously for the DM-3.1 base liner construction. This compaction window was defined by a minimum moisture content of 16 percent, a minimum relative compaction of 90 percent, and a minimum degree of saturation of 80 percent.

CQA procedures consisted of monitoring placement, moisture conditioning, and measurement of in-situ moisture-density using a nuclear density gauge (ASTM D6938) and the drive cylinder method (ASTM D2937). Golder performed 211 nuclear moisture-density tests, resulting in a testing frequency of one test per 189 cy. This is 32 percent higher than the frequency identified in the CQA Plan, providing improved control on the low-permeability soil liner placement. In addition, samples of the low-permeability soils were obtained for laboratory testing including moisture content (ASTM D2216), particle-size distribution (ASTM D1140), Atterberg Limits (ASTM D4318), modified Proctor density (ASTM D1557), and hydraulic conductivity (ASTM D5084). The results of this testing are summarized in Appendix E.1. A summary of the in-situ moisture density testing is presented in Appendix E.2. CQA testing frequencies are summarized in Table 1.

TABLE 1

LOW-PERMEABILITY CQA TESTING FREQUENCIES

Parameter	Test Method	Minimum Specified Frequency	Number of Tests	Actual Construction Frequency
Moisture-Density	D1557	1 Per 5,000 or change in material	9	1 Per 4,444 CY
Nuclear Moisture-Density	D6938	1 Per 250 CY	211	1 Per 189 CY
Moisture Content	D2216/D4643	1 Per 1,500 CY	28	1 Per 1,428 CY
Sand Cone, or Drive Cylinder	D1556, D2937	1 Per 20 Nuclear Density Tests	19	1 Per 11 tests
Particle Size	D422/D1140	1 Per 1,500 CY	37	1 Per 1,351 CY
Atterberg Limits	D4318	1 Per 1,500 CY	37	1 Per 1,351 CY
Soil Classification	D2487/2488	1 Per 1,500 CY	37	1 Per 1,351 CY
Laboratory Hydraulic Conductivity on Field Collected Sample	D5084 at 15 psi	1 Per 1,500 CY	25	1 Per 1,600 CY

On average, the soils were compacted to a dry density of 110.7 pcf and a moisture content of 17.4%.

Permeability samples were obtained in 3-inch diameter Shelby tubes and transported to Sierra Testing Laboratories in El Dorado Hills, California. The results of the permeability testing indicated measured permeabilities ranged from 3.9×10^{-10} cm/s to 7.7×10^{-8} cm/s with an average of 1.1×10^{-8} cm/s. These permeability results are similar to, but slightly more favorable (i.e. lower), than those measured for the low-permeability soil used previously to construct DM-3.1.

The actual permeability testing frequency was slightly below that specified in the CQA Plan. However, Golder considers the permeability testing suitable for DM-3.2/3.3 based on the following:

- Increased field moisture-density testing (32% greater than required) that provided more certainty that the low-permeability soil liner was compacted within the proper moisture-density window, which is a key factor in achieving the specified permeability
- Consistency in the key physical properties including Plasticity Index and grain-size distribution for the low-permeability soil liner constructed for DM-3.2/3.3 and the previously constructed DM-3.1 liner system
- Consistency in the measured laboratory permeability for all 25 tests for DM-3.2/3.3 and the similarity in values to the permeabilities measured on the low-permeability soil liner constructed for DM-3.1. This indicates that measured permeabilities on the low-permeability soil liner consistently meet or exceed specification requirements when this soil is properly compacted to the specified moisture-density window

The top of the primary low-permeability soil liner was surveyed to verify that the design thickness and grades were achieved. The as-built plan is included in Appendix C.

The results of the CQA observations, field and laboratory testing, and surveying indicate that the primary low-permeability soil liner material was placed in general compliance with the project specifications.

4.0 LCRS, LEAK DETECTION, AND LYSIMETER GRAVELS

The leachate collection and recovery system (LCRS) consists of a 0.5-foot thick layer of 3/8-inch pea gravel spread across the floor of the cell over the 60-mil HDPE primary geomembrane. The LCRS gravel materials were also placed in the lysimeter and leak detection sumps. Additionally, LCRS collection pipes were installed on the floor. BPI began welding LCRS collection pipe on August 12, 2010 and began placing LCRS gravel on August 16, 2010. HDPE piping materials were obtained from ISCO Industries.

The LCRS gravel was supplied by Cemex located in Madison, California. Approximately 10,430 cy of gravel was hauled to the site in transfer dump trucks. Placement began in the southwest corner of DM-3.3 and was placed westward to cover DM-3.2 then placed northward to cover DM-3.3. Placement was performed by pushing out gravel in 3 to 5 foot thick "roads" with a D8 dozer from the leading edge of operations layer. The roads were then spread into a 6-inch thick lift with a D6LGP dozer. As segments of the LCRS gravel layer were completed, 8 oz/sy nonwoven geotextile was deployed over the gravel. Water was then sprayed over the gravel as the LCRS layer was covered with operations layer materials. BPI spread and graded the LCRS gravel using a Caterpillar D6 low-ground pressure (LGP) dozer operating on a base of approximately 6-inches of gravel. The dozer used global positioning system (GPS) guided survey equipment to provide grade control.

Samples were obtained from the gravel that was delivered to the site. The samples were tested for grain-size (ASTM D422), fractured faces (ASTM D5821), and permeability (ASTM D2434). The measured permeability exceeded the minimum requirement of 1.0 cm/s and averaged 3.2 cm/s. The gravel met the maximum particle-size requirement (100 percent less than 1/2-inch minus, 100 to 85 percent less than the 3/8-inch sieve, 0 to 30 percent less than the #4 sieve, and the maximum fines content - a maximum of 2 percent less than the U.S. No. 200 sieve). The percentage of particles 3/8-inch or larger with more than one fractured face was measured between 10 and 19 percent, which was less than the 25 percent maximum value.

The CQA testing frequencies met or exceeded the CQA plan requirements and are detailed in Table 2.

TABLE 2
LCRS GRAVEL CQA TESTING FREQUENCIES

Parameter	Test Method	Minimum Specified Frequency	Number of Tests	Actual Construction Frequency
Sieve Analysis	D422/C136	1 Per Source[1] 1 Test Per 1,500 CY	8	1 Per 1,303 CY
Visual Classification	D2488	Continuous Observation		Continuous Observation
Hydraulic Conductivity	D2434	1 Per Source[1] 1 Test Per 3,000 CY	6	1 Per 1,738 CY
Fractured Faces (Gravel Fraction Only)	D5821	1 Per Source[1] 1 Test Per 1,500 CY	8	1 Per 1,303 CY

Based on the survey data submitted by BPI, the thickness of the LCRS gravel was averaged 0.51 feet thick and was within design tolerances.

5.0 GEOSYNTHETICS

5.1 Review of Submittals and Material Conformance Testing

Geosynthetics utilized for the DM-3.2/3.3 base liner construction project consisted of the following components:

- 60-mil double-sided textured HDPE geomembrane liner
- Geocomposite drainage layer
- 8-oz. geotextile filter layer
- Geosynthetic clay liner (GCL) bonded with a 30-mil HDPE geomembrane backing sheet

Golder performed conformance testing of the HDPE geomembrane, geocomposite, geotextile, and GCL materials and reviewed the manufacturer's quality control certificates prior to use of the materials on the project. Copies of the manufacturer's quality control documentation are included in Appendix G as follows:

- Appendix G.1 – HDPE Geomembrane
- Appendix G.2 – Geocomposite
- Appendix G.3 – Geotextile
- Appendix G.4 – Geosynthetic Clay Liner

Conformance samples were obtained from the manufacturing plant or upon delivery to the site. Golder staff selected the rolls of materials for conformance sampling. Samples were shipped to Golder's Geosynthetics Laboratory in Atlanta, Georgia for conformance testing. Copies of the conformance tests results and test summaries are presented in Appendix H as follows:

- Appendix H.1 – HDPE Geomembrane
- Appendix H.2 – Geocomposite
- Appendix H.3 – Geotextile
- Appendix H.4 – Geosynthetic Clay Liner

Golder's technicians performed an inventory of the on-site materials to confirm that the roll numbers for each of the geosynthetic components correlated to the manufacturer's submittals and shipping manifests. Copies of the material inventories prepared by Golder are presented in Appendix I as follows:

- Appendix I.1 – HDPE Geomembrane
- Appendix I.2 – Geocomposite
- Appendix I.3 – Geotextile
- Appendix I.4 – Geosynthetic Clay Liner

The frequencies of conformance testing met or exceeded minimum frequencies specified in the CQA Plan, which are summarized below:

- HDPE Geomembrane: 12 tests for 1,159,000 square feet (min. required frequency of 1 test/150,000 s.f. required)
- Geocomposite: 4 tests for 597,000 square feet (min. of 1 test/250,000 required)
- Geotextile: 5 tests for 561,000 square feet (min. of 1 test/150,000 required)
- Geosynthetic Clay Liner: 2 tests for 55,000 square feet (min. of 1 test/150,000 required)

Based upon the manufacturer's quality control documentation and the results of the conformance tests, all of the geosynthetic materials used for the project were accepted. All of the conformance tests for the 60 mil HDPE, GCL, geocomposite, and geotextile met project specifications.

5.2 Geomembrane

A 60-mil double-sided, white, textured, HDPE, geomembrane liner was installed in the DM-3.2/3.3 primary and secondary liner systems and in both the pan lysimeters to the limits identified on the design drawings. The HDPE geomembrane was deployed following the completion of the grading and surveying of the primary low-permeability soil liner. Prior to geomembrane deployment, the subgrade was inspected to verify that it was suitable to support the geomembrane liners. Copies of the subgrade certificates are included in Appendix J.1.

The pan lysimeter and secondary HDPE geomembrane deployment began on June 30, 2010. The secondary geomembrane liner was completed on July 21, 2010. The primary HDPE geomembrane deployment began on August 10, 2010 and was completed on August 20, 2010.

The 60-mil HDPE geomembrane was deployed using an all-terrain forklift and a spreader bar. Each roll measured 22.5 feet wide by 520 feet long. A record of the deployment logs is presented in Appendix J.2. The record drawings representing the location of the liner panels were prepared by D&E and reviewed by Golder. These as-built record panel drawings are presented in Appendix C.

Golder observed the deployment and seaming of the 60-mil HDPE geomembrane installed by D&E. Prior to seaming operations, D&E performed trial seams at the beginning of each shift, or upon re-starting the machine after lunch breaks, to demonstrate the adequacy of the seaming apparatus and the operator's procedures. Each trial seam was sampled and tested by D&E for peel adhesion and bonded seam strength. These trial seaming procedures were observed and documented by Golder personnel. Upon observation of successful trial welds, the operators were given approval to begin seaming. Archive samples of trial welds were collected. Copies of the trial seam logs are presented in Appendix J.3.

In general, the split wedge fusion method was used for seaming of the HDPE geomembrane liner and ran concurrently with deployment of the geomembrane. This method of fusion seaming produces an air channel that is air-pressure tested for leaks. The extrusion seaming method was utilized for patches, small repairs, and the tie-in to the DM-3.1 liner system. Golder observed and documented the welding of all seams, patches, or other repairs either during or shortly after completion. Copies of the seaming logs are presented in Appendix J.4.

All non-destructive seam continuity testing was performed by D&E and observed by Golder. Non-destructive seam testing was required on all field seams and on all repairs including the destructive test sample patches. Two methods of non-destructive testing were used for this project:

- Vacuum testing on extrusion welds
- Air pressure testing on split wedge fusion welds

A vacuum box is a rigid-wall box with a clear Plexiglas top and a neoprene gasket around the bottom of the box forming a seal between the box and the HDPE liner. Vacuum testing procedures consist of the following:

- Applying a soapy water solution to the seam
- Applying a vacuum of approximately 10 inches of mercury (5 psi) to the inside of the box for 10 seconds
- Observing the weld for expanding bubbles which would indicate a discontinuity in the weld

Air pressure testing procedures consist of the following:

- Sealing off the air channel between the inside and outside tracks of the fusion weld at each end of the seam
- Inserting a needle with an attached pressure gauge into the air channel
- Inflating the air channel to approximately 40 psi using a small pressurized air tank
- Observing the pressure gauge over a five-minute period (a pressure drop of more than 2 psi during this period would indicate a possible discontinuity in the seam)
- Puncturing of the seam air channel at the far end of the seam to allow release of the pressurized air to verify testing was for the entire seam length

Any leaks or discontinuities detected in the seams or welds were marked and subsequently repaired in accordance with the specifications. As repairs were made to the geomembrane, Golder documented the location and verified that all repairs were vacuum box tested. Documentation summarizing the observation of the non-destructive seam testing is presented in Appendix J.5.

Repairs consisted of small patches, extrusion beads, or welds. Repairs were made along the intersection of panels, at cuts in the liner made for air pressure testing of the fusion welded seams, or for defects due to holes or blemishes observed in the liner from installation damage. The repairs were marked in the field by Golder and were then subsequently repaired by D&E. A summary of the Repair Logs is presented in Appendix J.6.

A summary of the destructive test results is presented in Appendix K.7. In the destructive test, ten (10) one-inch wide test coupons are cut from each destructive test sample. Five of the coupons are tested for adhesion (peel test mode, both inside and outside track for fusion seams) and five coupons are tested for bonded seam strength (shear test mode) in accordance with ASTM D6392. Breaks are analyzed for Film-Tear-Bond (FTB) or non-FTB in accordance with ASTM D6392.

Destructive test samples were obtained from the HDPE geomembrane seams at a maximum frequency of one sample per 500 lineal feet. A total of 135 destructive test samples were tested, resulting in an overall testing frequency of approximately one test per 465 feet of seam. The majority of theses samples were shipped off-site to Golder's geosynthetics laboratory in Atlanta, Georgia for testing; however, a two were tested in the field by Golder using the installer's tensiometer.

Test results indicated that all of the destructive seam tests met the project specifications.

5.3 Geocomposite

A geocomposite drainage layer was installed directly over the secondary 60-mil HDPE geomembrane liner as the leak detection layer on the floor of the landfill. In addition, a geocomposite drainage layer was installed over the primary 60-mil HDPE geomembrane layer on the side-slope as part of the LCRS.

The geonet component of the geocomposite layers was installed with a minimum 4-inch overlap between adjacent panel edges and fastened using plastic ties at a maximum spacing of 5 feet on panel edges and 1-foot across butt-seams. No butt-seams were placed on the slopes. The upper geotextile component was sewn continuously along seams in accordance with the project specifications.

Based on observations made by Golder, the geocomposite layers were installed in accordance with the project specifications.

5.4 Geotextile

An 8-oz/sy non-woven geotextile was installed as a filter layer above the LCRS gravel. D&E installed the geotextile above the LCRS gravel immediately following the placement and grading of the LCRS gravel layer.

The geotextile panels were seamed together with sewing equipment using polymeric thread. Golder verified that adequate seaming was performed and observed the general condition of the geotextile.

5.5 Geosynthetic Clay Liner

A Gundseal geosynthetic clay liner (GCL) was on the east and south perimeter levee slopes. Gundseal is a composite geosynthetic comprised of a bentonite layer bonded to a 30-mil HDPE geomembrane. The Gundseal material was installed geomembrane side down on the majority of the east and south perimeter levee slopes beneath the primary geomembrane. However, four panels of an alternate material was installed at the north end of the east slope. This alternate material was procured due to a material shortage and potential schedule delays to obtain additional Gundseal material. The alternate material was comprised of GSE Bentoliner GCL installed along with 60-mil HDPE textured geomembrane. The geomembrane was installed first as a capillary barrier, and the Bentoliner GCL was then deployed directly on the geomembrane. The Gunderseal, 60-mil HDPE geomembrane, and Bentoliner GCL were deployed using an all-terrain forklift and a spreader bar. Prior to deployment, the subgrade was inspected by Golder and D&E to verify compliance with the project specifications.

Installation of the 40-mil geomembrane and overlying GCL was started on June 30, 2010 and completed on July 7, 2010. The primary 60-mil HDPE geomembrane was placed as soon as reasonably possible following the GCL installation to protect the GCL from hydration.

6.0 OPERATIONS SOILS

The operations layer soils were placed upon completion of the LCRS gravel, geotextile filter deployment, and LCRS geocomposite drainage layer installation. BPI placed the operations layer soils with transfer dump trucks and a Caterpillar D6 LGP dozer. A grader was used to finish-grade the final operations soil layer surface. The operations soil layer consisted of native borrow soils and a mixture of biosolids and soil, which were placed in specific areas delineated on the construction drawings.

Golder monitored the operations layer soil materials and the soil thickness by observing placement operations and thickness throughout the placement activities. Particle-size distribution tests and moisture content test results completed on the operations soil layer are included in Appendix K.

The placement of the operations layer was started on August 18, 2010. The operations layer and landfill composite liner system was substantially completed on September 14, 2010 with the exception of the outer edges of the liner system. The outer edges of the HDPE geomembrane were left exposed during the completion of the electrical leak location survey as discussed in Section 7. Following the completion of the electrical leak location surveys, the contractor finished placing the remaining operations soil layer materials on September 17, 2010.

The as-built plan prepared by Bellecci & Associates, Inc. is presented in Appendix C. Review of the as-built information indicates that the operations layer was constructed in general accordance with the design grades.

7.0 LEAK LOCATION SURVEY

An electrical leak location survey (ELLS) was performed in two stages in accordance with ASTM D7007. The first stage was completed east of the Phase line shown on Sheet 3 of the Drawings at the completion of the DM-3.2 operations soil layer placement between August 31 and September 2, 2010. The second stage was completed west of the Phase line at the completion of the DM-3.3 operations soil layer placement between September 15 and September 16, 2010. The ELLS was performed by Leak Location Services, Inc. (LLSI) under subcontract to Golder to determine if holes or defects existed in the primary 60-mil HDPE geomembrane liner following completion of the LCRS gravel and operations layer.

At the beginning of each survey, an artificial leak test was completed by placing a 1/4-inch diameter electrode at the top of the primary geomembrane to verify that the overlying gravels and operations soil could adequately conduct an electrical current. The results of the artificial leak test indicated that overlying materials were adequately conducting an electrical current.

The results of the first survey did not detect any defects in the primary HDPE geomembrane east of the phase line that includes DM-3.2 and the eastern portion of DM-3.3. The results of the second survey detected one defect consisting of 3 holes in the primary HDPE geomembrane west of the phase line. The detected defect was repaired by D&E on September 16, 2010. Appendix L includes two reports from LLSI that describes the methodology and results of the survey.

8.0 LEACHATE EXTRACTION AND GAS COLLECTION SYSTEMS

Following the construction of the base liner system, the leachate extraction system was installed. At the time that this report was prepared, this work is ongoing. The leachate extraction system is being installed by Advance Wind, Solar, Hydro Power, Inc. (Advanced Power), Redwood Valley, California.

The leachate extraction system consists of four Grundfos submersible pumps, two installed in each of DM-3.2 and DM-3.3 LCRS riser pipes, and two installed in each of the DM-3.2 and DM-3.3 LDS riser pipes. These pumps are automatically controlled by a sump level detection system. Custom flange adaptors were installed on the tops of the riser pipes to provide connection ports for hoses, sampling, and level detection equipment. For each sump, a hose is provided between the LDS pump and the LCRS riser pipe to remove liquids from the LDS sump. This pipe can be switched from the LDS riser pipe flange to the lysimeter riser pipe flange as necessary if pumping is required. An individual pipe for each of the DM-3.2 and DM-3.3 sumps is extended from the LCRS pump to a leachate storage tank located on the west side of Waste Pile 9 (WP-9). This pipe extends above-ground around the around the east and north sides of the perimeter of the landfill. The pumps are powered from a bank of batteries housed in a small shed located adjacent to the riser pipes. The batteries are charged from a bank of solar panels located on the shed roof. As an alternate power source, a generator is also housed in the shed.

A port was installed for future connection to the gas collection system at each of the LCRS riser pipes. This port consists of a 2-inch diameter HDPE stub out pipe welded to the pipe side near the top of the riser pipes.

9.0 LEAK DETECTION MONITORING CONSIDERATIONS

Water will enter the leak detection system as the liner system is loaded with refuse and the primary low-permeability soil layer consolidates. This is a common occurrence in double-liner systems containing compacted clay liners. This consolidation water is not indicative of a leak in the primary liner system.

The consolidation will generally increase as the refuse loading increases and will significantly decrease after the refuse loading remains constant. Therefore, the occurrence of consolidation water should correlate to increasing refuse loading in the waste cell.

10.0 SUMMARY AND CONCLUSIONS

Golder provided CQA and testing services during construction of the Disposal Modules 3.2 and 3.3 base liner system at the Recology Hay Road facility in Vacaville, California. Construction of the base liner system covered by this CQA Report occurred between June 17, 2010 and September 20, 2010. Additional construction to install the leachate extraction system began on September 7, 2010 and is currently ongoing. An addendum to this CQA Report will be issued following completion of the liner system construction, including the DM-3.3 operations layer and the leachate extraction system for DM-3.2 and DM-3.3.

The CQA services provided for this project consisted of observing, testing, and documenting the construction activities to verify compliance with the project design plans and specifications. The CQA activities described in this report include the following:

1. Observation and testing the general earthfill soils beneath the liner systems
2. Observation of the liner subgrade
3. Observation of the lysimeter and leak detection systems
4. Observation and testing of the low-permeability soil liner
5. Observation and testing of the geomembrane, geocomposite, geotextile, and GCL materials
6. Observation and testing of the LCRS gravel and operations soils construction
7. Completion of an ELLS
8. Review and verification of the containment system as-built documents

Based on the daily communications with CQA technicians, on observations made during site visits, and on review of the laboratory and field test results and documentation provided and certified by others, Golder hereby states that, in our professional opinion, the containment system constructed through September 20, 2010 for the DM-3.2 and DM-3.3 base liner at the Recology Hay Road Facility was constructed in accordance with the project plans and specifications, WDR Order No. R5-2008-0188, and the applicable requirements of the California Code of Regulations, Title 27 pertaining to a Class II Landfill.

Respectfully submitted,

GOLDER ASSOCIATES INC.

REGISTERED PROFESSIONAL ENGINEER
PETER E. BOWERS
C 65436
EXP. 9-30-11
CIVIL
STATE OF CALIFORNIA

Peter. E. Bowers, P.E.
Senior Engineer/CQA Engineer-of-Record

11.0 REFERENCES

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